PATENT ABSTRACTS OF JAPAN

BEST AVAILABLE COPY

(11)Publication number : 11-069491

(43)Date of publication of application : 09.03.1999

(51)Int.Cl. H04R 17/00
H04R 17/00

(21)Application number : 09-240414

(22)Date of filing : 19.08.1997

(71)Applicant : MIYOTA CO LTD
CITIZEN WATCH CO LTD

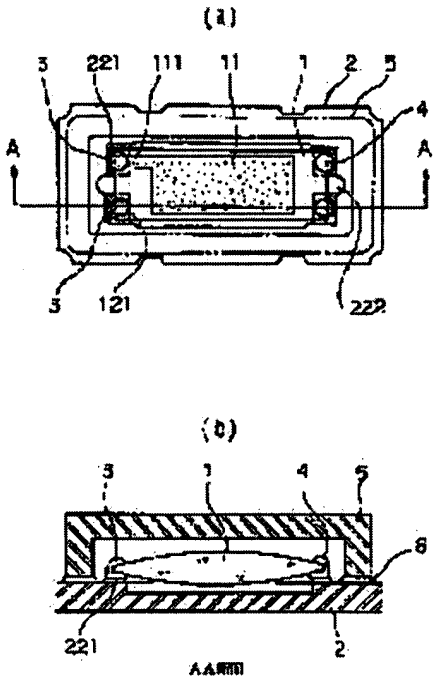
(72)Inventor : IDE TOSHINORI
WAKABAYASHI HISAO

(54) PIEZOELECTRIC VIBRATOR

(57)Abstract:

PROBLEM TO BE SOLVED: To provide a piezoelectric vibrator contained in a box, which has excellent quality and performance capable of effectively cancelling residual stress due to adhesion and additional stress due to temperature change in the piezoelectric vibrator provided with the piezoelectric vibration piece of twin support.

SOLUTION: One side of the piezoelectric vibration piece 1 in an almost rectangular plate shape is fixed to the two parts of a lower case 2 by a relatively hard conductive adhesive material 3 and the side opposite to the one side is fixed to the two parts of the other part of the lower case 2 by a relatively soft adhesive material 4. A cover 5 for covering the piezoelectric vibration piece 1 and the lower case 2 are sealed by using a low melting point glass material 6 whose melting point is below 340°C for a vibrator container.



LEGAL STATUS

[Date of request for examination] 23.07.2004

[Date of sending the examiner's decision of rejection]

[Kind of final disposal of application other than the examiner's decision of rejection or application

converted registration]

[Date of final disposal for application]

[Patent number]

[Date of registration]

[Number of appeal against examiner's decision of rejection]

[Date of requesting appeal against examiner's decision of rejection]

[Date of extinction of right]

Copyright (C); 1998,2003 Japan Patent Office

PATENT ABSTRACTS OF JAPAN

(11)Publication number : 11-069491

(43)Date of publication of application : 09.03.1999

(51)Int.Cl. H04R 17/00

H04R 17/00

(21)Application number : 09-240414

(22)Date of filing : 19.08.1997

(71)Applicant : MIYOTA CO LTD

CITIZEN WATCH CO LTD

(72)Inventor : IDE TOSHINORI

WAKABAYASHI HISAO

(54) PIEZOELECTRIC VIBRATOR

(57)Abstract:

PROBLEM TO BE SOLVED: To provide a piezoelectric vibrator contained in a box, which has excellent quality and performance capable of effectively cancelling residual stress due to adhesion and additional stress due to temperature change in the piezoelectric vibrator provided with the piezoelectric vibration piece of twin support.

SOLUTION: One side of the piezoelectric vibration piece 1 in an almost rectangular plate shape is fixed to the two parts of a lower case 2 by a relatively hard conductive adhesive material 3 and the side opposite to the one side is fixed to the two parts of the other part of the lower case 2 by a relatively soft

adhesive material 4. A cover 5 for covering the piezoelectric vibration piece 1 and the lower case 2 are sealed by using a low melting point glass material 6 whose melting point is below 340°C for a vibrator container.

LEGAL STATUS

[Date of request for examination] 23.07.2004

[Date of sending the examiner's decision of rejection]

[Kind of final disposal of application other than the examiner's decision of rejection or application converted registration]

[Date of final disposal for application]

[Patent number]

[Date of registration]

[Number of appeal against examiner's decision of rejection]

[Date of requesting appeal against examiner's decision of rejection]

[Date of extinction of right]

Copyright (C); 1998,2003 Japan Patent Office

* NOTICES *

JPO and NCIPI are not responsible for any damages caused by the use of this translation.

1.This document has been translated by computer. So the translation may not reflect the original precisely.

2.**** shows the word which can not be translated.

3.In the drawings, any words are not translated.

CLAIMS

[Claim(s)]

[Claim 1] The piezoelectric transducer characterized by having fixed one side of a tabular piezo-electric oscillating piece to two places of a bottom case with comparatively hard electric conduction adhesives, having fixed to two places of other parts of said bottom case the side which counters one [said] side with comparatively elastic adhesives, and closing said piezo-electric oscillating piece using the low-melting-glass material whose melting point is below 340-degreeC about a wrap lid and said bottom case.

[Claim 2] Comparatively elastic adhesives are piezoelectric transducers according to claim 1 characterized by applying only to the bottom case side of a piezoelectric transducer.

[Claim 3] It is the piezoelectric transducer according to claim 1 or 2 which said bottom case and a lid are the products made from a ceramic, and said comparatively hard electric conduction adhesives are macromolecule system heat viscosity adhesives, and is characterized by said comparatively elastic adhesives being the adhesives of a silicon system non-conducting current.

[Claim 4] Said comparatively hard electric conduction adhesives are piezoelectric transducers according to claim 3 characterized by being the adhesives which used polysulphone resin as the base material and added the silver flake.

[Translation done.]

* NOTICES *

JPO and NCIPI are not responsible for any
damages caused by the use of this translation.
1.This document has been translated by computer. So the translation may not reflect the original precisely.
2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

DETAILED DESCRIPTION

[Detailed Description of the Invention]

[0001]

[Field of the Invention] This invention relates to support of the piezo-electric oscillating piece in a piezoelectric transducer, and the structure of a container.

[0002]

[Description of the Prior Art] Piezoelectric transducers, such as a quartz resonator, are supported in the tight container of the core box often made from ingredients, such as a ceramic. A certain thing of the piezoelectric transducer enclosed with the container of a core box is called surface mount mold (SMD mold) vibrator, is suitable for mounting to the circuit board to which the printed circuit of the electronic equipment was carried out, and is used abundantly as sources of a clock, such as communication equipment and a portable electronic device, etc. The piezo-electric oscillating piece used is a Xtal oscillating piece of the rectangle stencil AT cut of the shape of a strip of paper as shows facies in the perspective view of drawing 2 . In drawing, 1 is a Xtal oscillating piece and 11 is a Xtal oscillating piece electrode layer. There is the same electrode layer also as the rear face of the Xtal oscillating piece 1. 111 121 It is those electrode leader lines and is prepared ranging over both sides of the edge of the Xtal oscillating piece 1.

[0003] When an example of the core box container for SMD is given, it consists of the lid 5 as shown in the perspective view of the bottom case 2 as shown in

the decomposition perspective view of drawing 3 R> 3, and drawing 4 . The 1st insulating substrate 21 and the 2nd insulating substrate 22 of the product [case / 2 / bottom] made from a ceramic respectively are stuck. The 1st insulating substrate 21 is the underside electrode terminal 211 for SMD to an underside, and it and the side-face pattern 212. It connects and he is the through hole connection 214 to the key point. Circuit pattern 213 which it has It has as a pattern by which metallizing was carried out.

[0004] In the top face of the 2nd insulating substrate 22, they are four terminals 221 for oscillating pieces. It is the circuit pattern 213 on the 1st insulating substrate 21 by the through hole (not shown) which is prepared as a metallizing pattern and is in the field. It connects. Four terminals 221 for oscillating pieces An adjoining thing serves as two terminals and the thing comrade on the diagonal line is connected. And the Xtal oscillating piece 1 is carried on the bottom case 2, and it is the terminal 221 for oscillating pieces. It is the electrode leader line 111 of the Xtal oscillating piece 1, and 121 upwards. As it rides, it pastes up with electroconductive glue, and a flow and support are made to attain simultaneously. At this time, the front flesh side of the Xtal oscillating piece 1 and the sense of a longitudinal direction are not asked. A lid 5 is put on the bottom case 2 which mounted the Xtal oscillating piece 1, and seals a perimeter underside airtightly using the bottom case 2 and low melting glass. Hole 222 established in the 2nd insulating substrate 22 Since the bottom case 2 cannot be touched at a part with the large vibration amplitude of the center of the Xtal oscillating piece 1, it is, and it is the inside slot 223. It is prepared in order to avoid the short circuit of adjoining electroconductive glue. The detail of the structure of the core box container explained above is the same as the thing and basic target which were indicated by Japanese Patent Application No. No. 316064 [seven to].

[0005] The approach of support of a piezo-electric oscillating piece is divided roughly, and there are two kinds. The (1) is both **** support, and both paste up two shorter sides of a piezo-electric oscillating piece with a bottom case with adhesives conductive or conductive, and non-conductive. It is a cantilevered

suspension, and the (2) pastes up only the side which has one electrode leader line between two shorter sides of a piezo-electric oscillating piece with a bottom case (upper terminal 221 for vibrator), and electric conduction adhesives, and it does not paste up but it makes the shorter side of another side free. the reinforcement which can bear a piezo-electric oscillating piece enough at an impact -- supporting -- in addition -- and in order to make it the stress (or for it not to interfere even if it calls it distortion) by support not have an adverse effect on the oscillation of a piezo-electric oscillating piece, there are various amelioration proposals from the former about both manners of support.

[0006] Although there is an advantage as for which a container is made to a thin shape since the good shock resistance which is extent to which destruction of a piezoelectric transducer does not take place is obtained and a piezo-electric oscillating piece does not move by the approach of both **** support the above (1) According to the difference of the substrate of the contraction and the piezo-electric oscillating piece by the cure (heat treatment for hardening) of adhesives, and a container, or coefficient of thermal expansion with adhesives Residual stress arises, an oscillation frequency aims, shift from a value, the temperature characteristic of a frequency or CI value is disturbed, or spurious one arises, it wins and comes out, and a certain difficulty is in the interior of the piezo-electric oscillating piece of a completion piezoelectric transducer. In order to avoid it, in JP,1-143516,U, electroconductive glue (generally contraction is large) is given to the adhesives to which adhesives with small contraction are given by non-conductive on the underside of each shorter side of the oscillating piece by which both **** support is carried out at a top face, and they have the proposal which prevents property degradation by residual stress. Moreover, in JP,5-18121,U, the shorter side of one side of a piezo-electric oscillating piece is supported with electric conduction adhesives (a degree of hardness is large), and when other shorter sides use elastic silicon system adhesives, the proposal which aimed at relief of residual distortion and absorption of many stress is made.

[0007] When a strong impact is impressed to a piezoelectric transducer by the

approach of the cantilevered suspension the above (2) if it remains as it is since a piezo-electric oscillating piece is a cantilever although it is almost satisfactory about the point that the oscillation of a piezo-electric oscillating piece is not influenced of the stress of support, risk, such as peeling like jointing and a crease of a piezo-electric oscillating piece, is large. In order to avoid it, there are some which formed the stopper which approaches the shorter side of the freer one and restricts the variation rate of a piezo-electric oscillating piece. The structure which has arranged the pillow part which serves as a stopper at the shorter side side which is not pasted up, and the buffer section in JP,8-330886,A as the example is indicated. Moreover, by applying the 1st adhesives to the attaching part of the cantilever of a Xtal oscillating piece, carrying out the temporary cure of this to extent to which a solvent flies, carrying a Xtal oscillating piece on it, applying the 2nd adhesives, and carrying out the cure of the whole to JP,8-186457,A Contraction by the cure of adhesives is controlled moderately, the free other end of a Xtal oscillating piece is slightly floated from a substrate, and the technique of obtaining the clearance between optimum dose between the substrate side which serves as a stopper, and the other end of a Xtal oscillating piece is indicated.

[0008] The trouble about each above-mentioned example of concrete amelioration by which the conventional proposal was made is described below. Since distortion clearance is the local operation in the shorter side which is mainly one side, the double spreading technique of the adhesives of JP,1-143516,U about both **** support of (1) has a query in extent of effectiveness. Although the thickness and cost of the mainstream of the SMD mold vibrator marketed actually of a piezoelectric transducer increase, it pastes up each shorter side of a Xtal oscillating piece on a flat spring, and its distortion clearance is in drawing. Moreover, although it is expected that the combination of hard and soft both the adhesives in JP,5-18121,U is effective, in a form which a manufacturing method completes, it is not written to the reference concerned, and a difficulty is in the implementability. That is, the elasticity adhesives of a

silicon system are disassembled in about 350-degreeC. However, it is 370-degreeC which has the conventionally low sealing temperature of the low melting glass which seals the lid of a core box container, and a bottom case. Therefore, if a sealing activity is done, it will decompose, the generated component will disperse, and the silicon system adhesives inside a container will adhere to the front face of a Xtal oscillating piece, and will shift a frequency. An affix has a possibility of it being unstable and dropping out, and causes aging of a frequency. Moreover, generating gas may spoil the ambient atmosphere or degree of vacuum inside a container, and may have an adverse effect also on CI value or the temperature characteristic. It seems that and the reference which made reference about such a difficulty does not exist. The point which has not completed the technique of forming the stopper of JP,8-330886,A in the cantilevered suspension of (2) as a manufacturing method, either is the same, and has not mentioned a stopper's optimal construction material, either.

[0009]

[Problem(s) to be Solved by the Invention] The object of this invention is realizing the piezoelectric transducer of the core box container which could absorb effectively the residual stress by adhesion, and the addition stress by the temperature change, and was moreover excellent in quality and the engine performance in the piezoelectric transducer which has the piezo-electric oscillating piece of both **** support.

[0010]

[Means for Solving the Problem]

(1) The piezoelectric transducer which fixed one side of an almost rectangle tabular piezo-electric oscillating piece to two places of a bottom case with comparatively hard electric conduction adhesives, fixed to two places of other parts of said bottom case the side which counters one [said] side with comparatively elastic adhesives, and closed said piezo-electric oscillating piece using the low-melting-glass material whose melting point is below 340-degreeC about a wrap lid and said pedestal.

(2) Comparatively elastic adhesives are the piezoelectric transducers of (1) applied only to the bottom case side of a piezoelectric transducer.
(3) It is the piezoelectric transducer of (1) and (2) said bottom case and whose lid are the products made from a ceramic and, said whose comparatively hard electric conduction adhesives are macromolecule system heat viscosity adhesives said whose comparatively elastic adhesives are the adhesives of a silicon system non-conducting current.
(4) Comparatively hard electric conduction adhesives are the piezoelectric transducers of (3) which is the adhesives which used polysulphone resin as the base material and added the silver flake.
[0011]
[Embodiment of the Invention] Drawing 1 shows the piezoelectric transducer which is an example of the gestalt of operation of this invention, (a) is the top view (condition except a lid), and (b) is the A-A sectional view (with a lid). The same number is given to the part which already substituted explanation for the conventional example, and new explanation is omitted. They are each part (refer to drawing 2) of the Xtal oscillating piece 1, each part of the bottom case 2 (the 1st insulating substrate 21 and the 2nd insulating substrate 22 which were shown in drawing 3 in all [flare] thing formed into the 1 body), and a lid 5 (refer to drawing 4).
[0012] Setting to drawing 1 (a) and (b), two electric conduction adhesives 3 are the electrode leader line 111 of the Xtal oscillating piece 1, and 121. Two terminals 221 for vibrator of the bottom case 2 It pastes up, and it fixes mechanically at the same time it takes those electric flows. Since it is on one shorter side, although spacing like two jointing is short, since it is too influenced of thermal stress, the electric conduction adhesives which used the thermosetting epoxy resin etc. as the base material, for example may have a too hard degree of hardness after hardening. In order to fully ease thermal stress, the electric conduction adhesives which are slightly supple are used. The electric conduction adhesives which mixed the silver flake in this using the resin, for example, the

polysulphone resin, of heat viscosity (thermoplasticity) which is a macromolecule system rather than thermosetting resin are suitable for it. Other shorter sides of the Xtal oscillating piece 1 are other two terminals 221 for vibrator of a bottom case by the elasticity adhesives 4 of a non-conductive (insulation) silicon system. It pastes up. Since the elasticity adhesives 4 have flexibility, it not only eases all the stress (distortion) remained or generated in process of an activity after the assembly of a piezoelectric transducer, but it improves shock resistance further. Drawing 5 is a sectional view in the example which applied elasticity adhesives only between the underside of a piezo-electric oscillating piece, and the bottom case. Compared with the structure to which the piezo-electric oscillating piece applied the elasticity adhesives 4 up and down like drawing 1 , the frequency shift amount before and behind closure can be reduced. For example, when the quartz resonator with a nominal frequency of 4.8MHz compared, by the average value of a shift amount, -23.2 ppm has decreased to -5.1ppm, and the standard deviation of variation has decreased from 19.7 ppm to 4.3 ppm. The sealing glass 6 of a low-melt point point closes the bottom case 2 and a lid 5 airtightly. According to a sealing activity, the sealing temperature of this glass is about 320-degreeC actually below 340-degreeC, and is not decomposed, or the elasticity adhesives 4 do not deteriorate.

[0013] Originally the elasticity adhesives used for the gestalt of this operation were developed for the stress relaxation die bondings of a semi-conductor with the non-conductivity type of for example, 1 acidity or alkalinity, and are hardened and pasted up on the shape of an elastomer with spreading and heating for a short time. the main properties after hardening -- 25-degreeC -- tensile strength 22 kgf/cm2, 220% of ductility, Young's modulus 11 kgf/cm2, and adhesive strength 6.5 kgf/cm2 it is . in addition, the Young's modulus of the electric conduction adhesives for support immobilization -- 42000 kgf/cm2 it is -- since -- the Young's modulus of elasticity adhesives -- about [the] -- there is only 1/3800 and it is turned out how to be flexible. 500 or more, a certain thing is desirable and, as for the ratio of the Young's modulus of the electric conduction adhesives

and elasticity adhesives which are used for this invention, a certain thing is considered to be still more desirable 1000 or more. moreover, sealing glass -- a plumbic acid ghost -- a principal component -- carrying out -- ceramic material (aluminum 2O3) of a case the additive for doubling coefficient of thermal expansion -- in addition, though it is a low-melt point point of 320-degreeC which is not in the former, it is the glass material which acquired properties (reinforcement, moisture resistance, etc.) comparable as the former.

[0014] The gestalt of other operations of this invention is described. It may not be, plate-like is sufficient, and a disk mold is [the necessity limited to a piezo-electric oscillating piece with the so-called BAIKOMBEKKUSU type as showed the piezo-electric oscillating piece to drawing 2 of thick center section may not be a rectangle plate, or] sufficient as it. In the case of a disk mold, it is understood as the partial radii which are near the ends of a certain diameter with the side which counters. Piezoelectric material other than Xtal is sufficient also as the construction material of a piezo-electric oscillating piece. Moreover, it is not restricted to the thing of the structure which also showed the container to drawing 3 R> 3. What is necessary is just the container in which closure is performed with low melting glass in short. Moreover, the number of electric conduction adhesives may increase according to the number of electrodes. It is not restricted to especially the thing that also illustrated the construction material of elasticity adhesives, and the construction material of sealing glass. It is not restricted to the place which also described the sequence like mounting of a piezo-electric oscillating piece, or the erector of a piezoelectric transducer, and conditions above.

[0015]

[Effect of the Invention] Since the container was closed using the sealing glass of the low-melt point point which carries out fixed support of one side of a piezo-electric oscillating piece with electric conduction adhesives, and connects in this invention, and pastes up the side of another side on a bottom case with elasticity adhesives, and elasticity adhesives do not decompose Since there are few shifts

of the frequency by closure, the property of elasticity adhesives is demonstrated that there is nothing with regret, and the residual stress in mounting of a piezo-electric oscillating piece is almost eased and there is also almost no addition stress by service temperature change etc. Since there was almost no frequency drift in assembly, there were also no abnormalities of the temperature characteristic, it excelled also in shock resistance by the buffer effect of elasticity adhesives and a piezo-electric oscillating piece did not move within a container, the tooth space of an excess was able to be made unnecessary and thin shape-ization of a container was also able to be attained. Moreover, if macromolecule system heat viscosity resin is used for electric conduction adhesives, the implementability can be raised further.

[Translation done.]

* NOTICES *

JPO and NCIPI are not responsible for any
damages caused by the use of this translation.
1.This document has been translated by computer. So the translation may not reflect the original precisely.
2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]
[Drawing 1] An example of the gestalt of operation of this invention is shown and the top view where (a) removed the lid, and (b) are A-A sectional views.
[Drawing 2] It is the perspective view showing an example of a piezo-electric oscillating piece.

[Drawing 3] It is the decomposition perspective view showing an example of a bottom case.

[Drawing 4] It is the perspective view of an example of a lid.

[Drawing 5] Drawing 5 is a sectional view in the example which applied elasticity adhesives only between the underside of a piezo-electric oscillating piece, and the bottom case.

[Description of Notations]

1 Xtal Oscillating Piece

11 Xtal Oscillating Piece Electrode

111 Electrode Leader Line

121 Electrode Leader Line

2 Bottom Case

21 1st Insulating Substrate

211 Underside Electrode Terminal

212 Side-Face Pattern

213 Circuit Pattern

214 Through Hole Connection

22 2nd Insulating Substrate

221 Terminal for Vibrator

222 Hole

223 Inside Slot

3 Electric Conduction Adhesives

4 Elasticity Adhesives

5 Lid

6 Sealing Glass

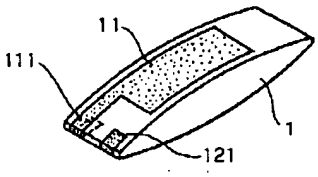
[Translation done.]

* NOTICES *

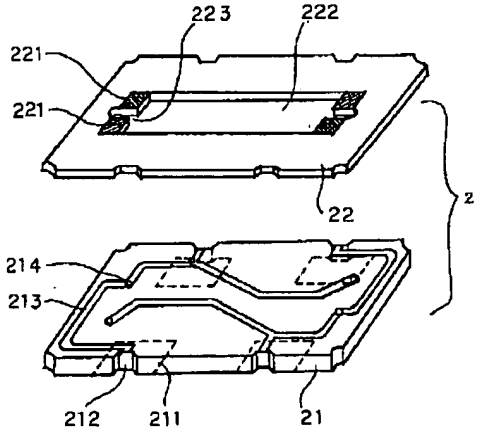
JPO and NCIPI are not responsible for any
damages caused by the use of this translation.
1.This document has been translated by computer. So the translation may not reflect the original precisely.
2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

DRAWINGS

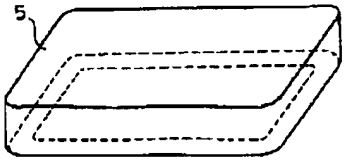
[Drawing 2]



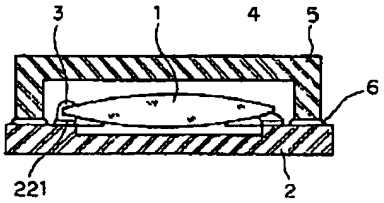
[Drawing 3]



[Drawing 4]

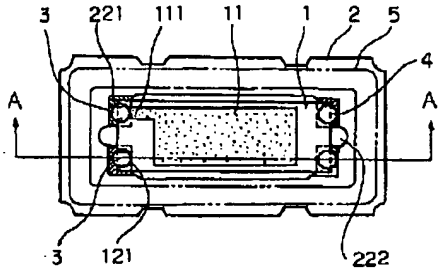


[Drawing 5]

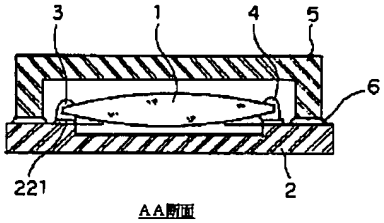


[Drawing 1]

(a)



(b)



AA断面

1	水晶振動片	2	下ケース	5	蓋
11	水晶振動片電極膜	221	振動片用端子	6	封着ガラス
111	電極引出線	3	導電接着剤		
121	電極引出線	4	軟質接着剤		

[Translation done.]

(19)日本国特許庁（ＪＰ）　(12)**公開特許公報**（Ａ）　(11)特許出願公開番号

特開平11－69491

(43)公開日　平成11年(1999)３月９日

(51)Int.Cl.[6]	識別記号	ＦＩ
Ｈ０４Ｒ　17/00	３３０	Ｈ０４Ｒ　17/00　３３０Ｇ

審査請求　未請求　請求項の数４　ＦＤ　（全５頁）

(21)出願番号　特願平9－240414

(22)出願日　平成９年(1997)８月19日

(71)出願人　000166948
ミヨタ株式会社
長野県北佐久郡御代田町大字御代田4107番地５

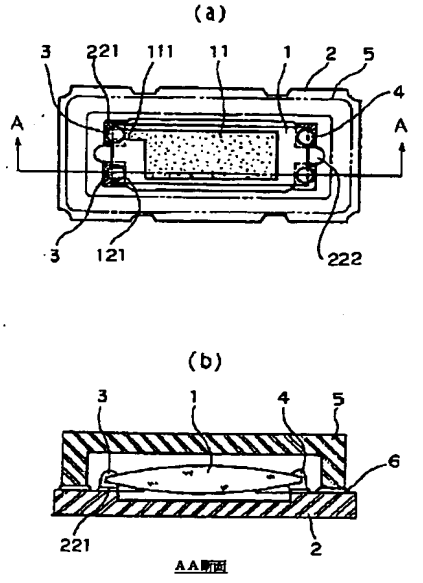
(71)出願人　000001960
シチズン時計株式会社
東京都新宿区西新宿２丁目１番１号

(72)発明者　井出　利則
長野県北佐久郡御代田町大字御代田4107番地５　ミヨタ株式会社内

(72)発明者　若林　久雄
東京都新宿区西新宿２丁目１番１号　シチズン時計株式会社内

(54)【発明の名称】　圧電振動子

(57)【要約】
【課題】　両持ち支持の圧電振動片を有する圧電振動子において、接着による残留応力や温度変化による付加応力を効果的に吸収することができ、しかも品質・性能の優れた箱型容器の圧電振動子を実現すること。
【解決手段】　ほぼ矩形板状の圧電振動片の一方の辺を比較的硬質の導電接着剤で下ケースの２箇所に固定し、前記一方の辺に対向する辺を比較的軟質の接着剤で前記下ケースの他の部分の２箇所に固定し、前記圧電振動片を覆う蓋と前記下ケースとを融点が３４０°Ｃ以下である低融点ガラス材を用いて振動子容器を封止した圧電振動子。



【特許請求の範囲】
【請求項１】　板状の圧電振動片の一方の辺を比較的硬質の導電接着剤で下ケースの２箇所に固定し、前記一方の辺に対向する辺を比較的軟質の接着剤で前記下ケースの他の部分の２箇所に固定し、前記圧電振動片を覆う蓋と前記下ケースとを融点が３４０°Ｃ以下である低融点ガラス材を用いて封止したことを特徴とする圧電振動子。
【請求項２】　比較的軟質の接着剤は圧電振動子の下ケース側のみに塗布することを特徴とする請求項１記載の圧電振動子。
【請求項３】　前記下ケースおよび蓋はセラミック製であり、かつ前記比較的硬質の導電接着剤は高分子系熱粘性接着剤であり、前記比較的軟質の接着剤はシリコン系の非導電接着剤であることを特徴とする請求項１または２記載の圧電振動子。
【請求項４】　前記比較的硬質の導電接着剤はポリサルホン樹脂を基材とし銀フレークを加えた接着剤であることを特徴とする請求項３記載の圧電振動子。
【発明の詳細な説明】
【０００１】
【発明の属する技術分野】本発明は圧電振動子における圧電振動片の支持および容器の構造に関する。
【０００２】
【従来の技術】水晶振動子等の圧電振動子は、しばしばセラミック等の材料で作られた箱型の気密容器内に支持される。箱型の容器に封入された圧電振動子の或るものは表面実装型（ＳＭＤ型）振動子と呼ばれ、電子機器のプリント配線された回路基板への実装に適し、通信機器、携帯用電子機器等のクロック源等として多用されている。使用される圧電振動片は、例えば図２の斜視図に概形を示すような短冊状の矩形板型ＡＴカットの水晶振動片である。図において、１は水晶振動片、11は水晶振動片電極膜である。水晶振動片１の裏面にも同様な電極膜がある。111 、121 はそれらの電極引出線で、水晶振動片１の端部の両面に跨がって設けられている。
【０００３】ＳＭＤ用の箱型容器の一例を挙げると、図３の分解斜視図に示すような下ケース２と図４の斜視図に示すような蓋５とより成る。下ケース２はそれぞれセラミック製の第１絶縁基板21と第２絶縁基板22とが貼り合わされたものである。第１絶縁基板21は下面にＳＭＤ用の下面電極端子211 、それと側面パターン212 にて接続され、要所にスルーホール接続部214 を有する配線パターン213 がメタライズされたパターンとして備えられている。
【０００４】第２絶縁基板22の上面には４個の振動片用端子221 がメタライズパターンとして設けられており、その面内にあるスルーホール（図示せず）によって、第１絶縁基板21上の配線パターン213 と接続されている。４個の振動片用端子221 は隣接するものが２端子となり、対角線上にあるもの同志は接続されている。そして下ケース２の上に水晶振動片１を搭載し振動片用端子221 の上に水晶振動片１の電極引出線111 、121 が乗るようにして導電性接着剤で接着し、導通と支持とを同時に達成させる。このとき水晶振動片１の表裏および長手方向の向きを問わない。蓋５は水晶振動片１をマウントした下ケース２に被せて周囲下面を下ケース２と低融点ガラスを用いて気密に封着する。第２絶縁基板22に設けられている穴222 は水晶振動片１の中央の振動振幅の大きい部分に下ケース２が触れないためにあり、また中溝223 は隣接する導電性接着剤の短絡を避けるために設けられている。以上に説明した箱型容器の構造の詳細は、特願平7-316064号に開示されたものと基本的に同じである。
【０００５】圧電振動片の支持の方法は大別して２種類ある。その（１）は両持ち支持で、圧電振動片の二つの短辺を両方とも導電性、或いは導電性と非導電性の接着剤で下ケースと接着する。その（２）は片持ち支持で、圧電振動片の２つの短辺のうち一方の電極引出線のある側のみを下ケース（上の振動子用端子221 ）と導電接着剤で接着し、他方の短辺は接着せずフリーにしておく。圧電振動片を衝撃に十分耐えうる強度に支持し、なおかつ圧電振動片の振動に支持による応力（あるいは歪みと言っても差し支えない）が悪影響を与えることがないようにするため、両支持方法に関して従来から種々の改良提案がある。
【０００６】前記（１）の両持ち支持の方法では、圧電振動子の破壊が起こらない程度の良い耐衝撃性が得られるし、圧電振動片が動かないので容器を薄型にできる利点があるが、接着剤のキュア（硬化のための熱処理）による収縮や圧電振動片と容器の基板、あるいは接着剤との熱膨張率の差によって、完成圧電振動子の圧電振動片内部に残留応力が生じて発振周波数が狙い値とずれたり、あるいは周波数やＣＩ値の温度特性が乱されたり、スプリアスが生じたりし勝ちである難点がある。それを回避するため、実開平1-143516号においては、両持ち支持される振動片の各短辺の下面に非導電性で収縮率の小さい接着剤を、上面に施される接着剤には導電性接着剤（一般的に収縮率が大きい）を施して、残留応力による特性劣化を防ぐ提案がある。また実開平5-18121 号においては、圧電振動片の片側の短辺を導電接着剤（硬度が大きい）で支持し、他の短辺は軟質のシリコン系接着剤を用いることによって残留歪みの軽減や諸応力の吸収を図った提案がなされている。
【０００７】前記（２）の片持ち支持の方法では、圧電振動片の振動が支持の応力の影響を受けないという点に関してはほとんど問題がないが、圧電振動片が片持ちであるため、そのままでは強度の衝撃が圧電振動子に印加されたとき、接着部位の剥がれ、圧電振動片の折れ等の危険が大きい。それを回避するため、フリーな方の短辺

に近接して圧電振動片の変位を制限するストッパーを設けたものがある。その具体例としては例えば特開平8-330886号においては、接着しない短辺側にストッパーとなる枕部や緩衝部を配置した構造が開示されている。また特開平8-186457号には、水晶振動片の片持ちの保持部に第１の接着剤を塗布してこれを溶剤が飛ぶ程度に仮キュアし、その上に水晶振動片を載せて第２の接着剤を塗布して全体をキュアすることによって、接着剤のキュアによる収縮を適度に制御し、水晶振動片のフリーな他端を基板から僅かに浮かせ、ストッパーとなる基板面と水晶振動片の他端との間に適量の隙間を得る技術が開示されている。

【０００８】従来提案された上記の各具体的改良例に関する問題点を以下に述べる。（１）の両持ち支持に関する実開平1-143516号の接着剤の２重塗布技術は、歪み除去が主として一方の短辺における局所的な作用であるので効果の程度に疑問がある。現に市販されているＳＭＤ型振動子の主流は圧電振動子の厚さやコストが増すにも関わらず、水晶振動片の各短辺を板バネ上に接着して歪み除去を図っている。また実開平5-18121 号における硬軟両接着剤の組み合わせは効果があると予想されるが、当該文献には製造法が完結されるような形では書かれてなく、その実現性に難点がある。即ちシリコン系の軟質接着剤は、約３５０°Ｃにおいて分解する。しかるに箱型容器の蓋と下ケースとを封着する低融点ガラスの封着温度は従来低いものでも３７０°Ｃである。従って封着作業を行うと容器内部のシリコン系接着剤は分解し、発生した成分が飛散し、水晶振動片の表面に付着して周波数をシフトさせてしまう。付着物は不安定で脱落する恐れがあり周波数の経時変化の原因になる。また発生ガスは容器内部の雰囲気あるいは真空度を損ない、ＣＩ値や温度特性にも悪影響を与える可能性がある。しかもこのような難点に関して言及した文献は存在しないようである。（２）の片持ち支持における特開平8-330886号のストッパーを設ける技術も製造法として完結していない点は同様であるし、またストッパーの最適材質にも言及していない。

【０００９】

【発明が解決しようとする課題】本発明の目的は、両持ち支持の圧電振動片を有する圧電振動子において、接着による残留応力や温度変化による付加応力を効果的に吸収することができ、しかも品質・性能の優れた箱型容器の圧電振動子を実現することである。

【００１０】

【課題を解決するための手段】

（１）ほぼ矩形板状の圧電振動片の一方の辺を比較的硬質の導電接着剤で下ケースの２箇所に固定し、前記一方の辺に対向する辺を比較的軟質の接着剤で前記下ケースの他の部分の２箇所に固定し、前記圧電振動片を覆う蓋と前記基台とを融点が３４０°Ｃ以下である低融点ガラス材を用いて封止した圧電振動子。

（２）比較的軟質の接着剤は圧電振動子の下ケース側のみに塗布した（１）の圧電振動子。

（３）前記下ケースおよび蓋はセラミック製であり、かつ前記比較的硬質の導電接着剤は高分子系熱粘性接着剤であり、前記比較的軟質の接着剤はシリコン系の非導電接着剤である（１）、（２）の圧電振動子。

（４）比較的硬質の導電接着剤はポリサルホン樹脂を基材とし銀フレークを加えた接着剤である（３）の圧電振動子。

【００１１】

【発明の実施の形態】図１は本発明の実施の形態の一例である圧電振動子を示し、（ａ）はその平面図（蓋を除いた状態）、（ｂ）はそのＡ－Ａ断面図（蓋つき）である。既に従来例にて説明を済ませた部分には同一番号を付して新たな説明を省略する。それらは、水晶振動片１の各部（図２参照）、下ケース２（図３に示した第１絶縁基板21および第２絶縁基板22を張り合わせて一体化したもの）の各部、および蓋５（図４参照）である。

【００１２】図１（ａ）、（ｂ）において、２ケ所の導電接着剤３は、水晶振動片１の電極引出線111 、121 と下ケース２の２ケ所の振動子用端子221 とを接着し、それらの電気的導通をとると同時に機械的に固着する。一方の短辺上であるから２ケ所の接着部位の間隔は短いとはいえ、やはり熱応力の影響を受けるので、例えば熱硬化性のエポキシ樹脂等を基材とした導電接着剤は硬化後の硬度が硬すぎる場合がある。熱応力を十分に緩和するためには僅かに柔軟性のある導電接着剤を使用する。それは熱硬化性樹脂よりも高分子系である熱粘性（熱可塑性）の樹脂例えばポリサルホン樹脂を用い、これに銀フレークを混入した導電接着剤が適当である。水晶振動片１の他の短辺は非導電性（絶縁性）のシリコン系の軟質接着剤４によって下ケースの他の２ヶ所の振動子用端子221 と接着される。軟質接着剤４は可撓性があるため圧電振動子の組立後に残留する、あるいは使用の過程で発生するあらゆる応力（歪み）を緩和するのみならず、耐衝撃性をも更に改善する。図５は軟質接着剤を圧電振動片の下面と下ケース間にのみ塗布した例で断面図である。図１のように軟質接着剤４を圧電振動片の上下に塗布した構造に比べ封止前後の周波数シフト量が低減できる。例えば、公称周波数４．８ＭＨｚの水晶振動子で比較するとシフト量の平均値で－２３．２ｐｐｍが－５．１ｐｐｍに、バラツキの標準偏差が１９．７ｐｐｍから４．３ｐｐｍに低減できた。低融点の封着ガラス６は下ケース２と蓋５とを気密に封止する。このガラスの封着温度は３４０°Ｃ以下、実際には約３２０°Ｃであり、封着作業により軟質接着剤４が分解あるいは変質することがない。

【００１３】本実施の形態に使用した軟質接着剤は、例えば１液性の非導電型で本来半導体の応力緩和ダイボン

ディング用に開発されたもので、塗布・加熱により短時間でエラストマー状に硬化、接着する。硬化後の主な特性は、２５°Ｃにて引張強度２２kgf/cm2 、伸度２２０％、ヤング率１１kgf/cm2 、接着力６．５kgf/cm2 である。なお支持固定用の導電接着剤のヤング率は４２００kgf/cm2 であるから、軟質接着剤のヤング率はその約１／３８００しかなく如何に柔軟かがわかる。本発明に用いられる導電接着剤と軟質接着剤とのヤング率の比は５００以上あることが好ましく、１０００以上あることが更に好ましいと考えられる。また封着ガラスは鉛酸化物を主成分とし、ケースのセラミック材(Al203) との熱膨張率を合わせるための添加剤を加えて、従来にない３２０°Ｃという低融点でありながら従来と同程度の特性（強度、耐湿性等）を得たガラス材である。

【００１４】本発明の他の実施の形態について述べる。圧電振動片は図２に示したようないわゆるバイコンベックス型の中央部が厚い圧電振動片に限定する必然性はなく、例えば平板状でもよいし、また矩形板でなくても例えば円板型でもよい。円板型の場合、対向する辺とはある直径の両端付近にある部分円弧と解される。圧電振動片の材質も水晶以外の圧電材料でもよい。また容器も図３に示した構造のものに限られない。要は低融点ガラスで封止が行われる容器であればよい。また導電接着剤の数が電極数に従って増えてもよい。軟質接着剤の材質、封着ガラスの材質も例示したものに特に限られない。圧電振動片のマウントや圧電振動子の組立工程の順序、条件も上に述べたところに限られない。

【００１５】

【発明の効果】本発明においては、圧電振動片の一方の辺を導電接着剤で固定支持しかつ接続し、他方の辺を軟質接着剤で下ケースに接着し、かつ軟質接着剤が分解しない低融点の封着ガラスを用いて容器を封止したので、封止による周波数のシフトが少なく、軟質接着剤の特性が遺憾なく発揮されて圧電振動片のマウントにおける残留応力が殆ど緩和され、また使用温度変化等による付加応力も殆どないので、組立における周波数変動が殆どなく、温度特性の異常もなく、軟質接着剤の緩衝効果により耐衝撃性にも優れ、圧電振動片が容器内で動かないため余分のスペースを不要とし容器の薄型化も達成することができた。また導電接着剤に高分子系熱粘性樹脂を用いれば一層その実現性を高めることができる。

【図面の簡単な説明】

【図１】本発明の実施の形態の一例を示し、（ａ）は蓋を取り除いた平面図、（ｂ）はＡ－Ａ断面図である。

【図２】圧電振動片の一例を示す斜視図である。

【図３】下ケースの一例を示す分解斜視図である。

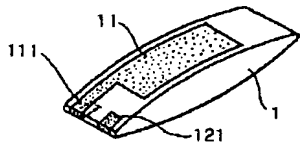
【図４】蓋の一例の斜視図である。

【図５】図５は軟質接着剤を圧電振動片の下面と下ケース間にのみ塗布した例で断面図である

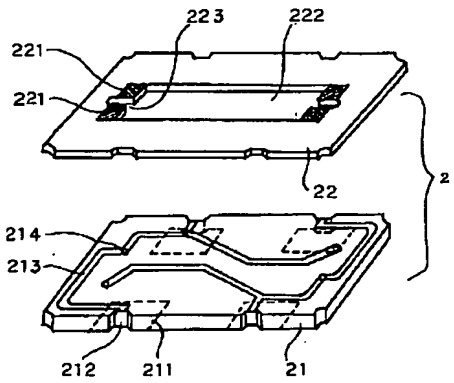
【符号の説明】

１　水晶振動片
１１　水晶振動片電極
１１１　電極引出線
１２１　電極引出線
２　下ケース
２１　第１絶縁基板
２１１　下面電極端子
２１２　側面パターン
２１３　配線パターン
２１４　スルーホール接続部
２２　第２絶縁基板
２２１　振動子用端子
２２２　穴
２２３　中溝
３　導電接着剤
４　軟質接着剤
５　蓋
６　封着ガラス

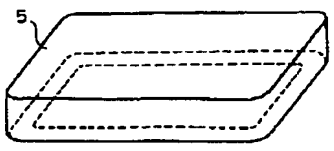
【図２】



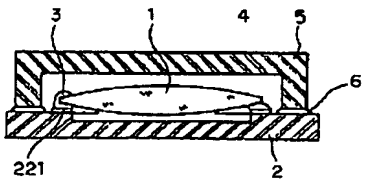
【図３】



【図４】

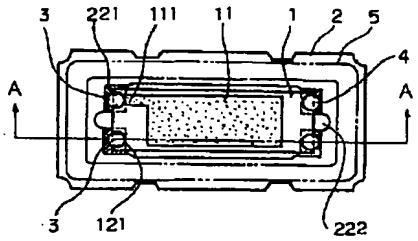


【図５】

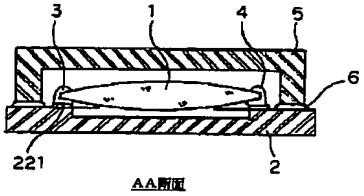


【図１】

(a)



(b)



AA断面

1	水晶振動片	2	下ケース	5	蓋
11	水晶振動片電極膜	221	振動片用端子	6	封着ガラス
111	電極引出線	3	導電接着剤		
121	電極引出線	4	軟質接着剤		

This Page is Inserted by IFW Indexing and Scanning Operations and is not part of the Official Record

BEST AVAILABLE IMAGES

Defective images within this document are accurate representations of the original documents submitted by the applicant.

Defects in the images include but are not limited to the items checked:

- ☐ BLACK BORDERS
- ☐ IMAGE CUT OFF AT TOP, BOTTOM OR SIDES
- ☑ FADED TEXT OR DRAWING
- ☑ BLURRED OR ILLEGIBLE TEXT OR DRAWING
- ☐ SKEWED/SLANTED IMAGES
- ☐ COLOR OR BLACK AND WHITE PHOTOGRAPHS
- ☐ GRAY SCALE DOCUMENTS
- ☑ LINES OR MARKS ON ORIGINAL DOCUMENT
- ☐ REFERENCE(S) OR EXHIBIT(S) SUBMITTED ARE POOR QUALITY
- ☐ OTHER: _____

IMAGES ARE BEST AVAILABLE COPY.

As rescanning these documents will not correct the image problems checked, please do not report these problems to the IFW Image Problem Mailbox.